(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 965 479 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.12.1999 Bulletin 1999/51

(51) Int Cl.[6]: **B60N 2/42**

(21) Application number: **99630052.1**

(22) Date of filing: **14.06.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **16.06.1998 JP 16843198**

(71) Applicant: **NHK SPRING CO.LTD.**
Yokohama-shi, Kanagawa-ken (JP)

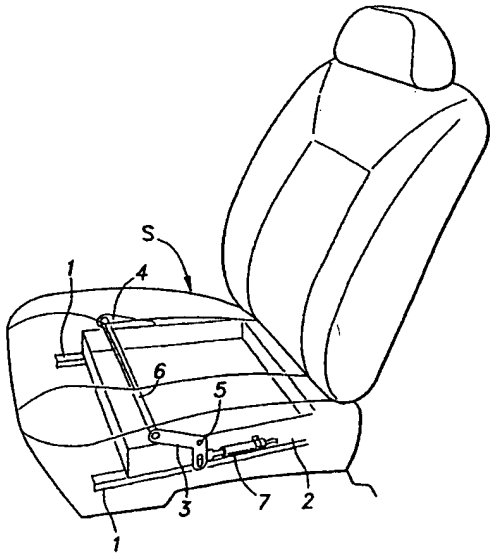
(72) Inventors:
- **Masuda, Kou, c/o NHK Spring Co., Ltd**
  Yokohama-shi, Kanagawa-ken (JP)
- **Yamaguchi, Hiroyoshi, c/o NHK Spring Co., Ltd.**
  Yokohama-shi, Kanagawa-ken (JP)
- **Ohi, Tomoharu, c/o NHK Spring Co., Ltd.**
  Yokohama-shi, Kanagawa-ken (JP)
- **Takakura, Minoru, c/o NHK Spring Co., Ltd.**
  Yokohama-shi, Kanagawa-ken (JP)

(74) Representative: **Weydert, Robert et al**
Dennemeyer & Associates Sàrl
P.O. Box 1502
1015 Luxembourg (LU)

(54) Vehicle Seat Assembly

(57) Provided is a vehicle seat assembly (S) which can prevent a submarine phenomenon in a reliable manner, and which is simple in structure so as to allow a high level of flexibility in layout. A slip preventing member (3, 4, 6) for preventing the vehicle occupant from slipping forward under the seat belt in case of an impact is supported by a fixed part (2) of a seat (S) so as to be pivotable between a retracted position and a raised position, and an actuator (7) is interposed between a fixed part (2) of said seat (S) and a part (3) of said slip preventing member (3, 4, 6). To retain the slip preventing member (3, 4, 6) at its raised position even after the power of the power unit (7) is all used up, the assembly further includes a lock mechanism for retaining said slip preventing member (3, 4, 6) at said raised position.

Fig. 1



EP 0 965 479 A2

Description

TECHNICAL FIELD

[0001] The present invention relates to a vehicle seat assembly, and in particular to a vehicle seat assembly which is adapted to prevent a vehicle occupant from slipping forward under a seat belt in case of an impact such as a vehicle crash.

BACKGROUND OF THE INVENTION

[0002] Conventionally is known a submarine phenomenon in which a vehicle occupant slips forward under a seat belt in case of an impact such as a vehicle crash, thereby causing the hip belt to dislodge from the hip bone of the vehicle occupant. This phenomenon tends to occur when the vehicle occupant sits on the front edge of the seat or when the seat back is tilted rearward, and could diminish the effectiveness of the seat belt in restraining the vehicle occupant because the seat belt is dislodged from the proper part of the vehicle occupant which is suited for restraining the vehicle occupant.

[0003] In view of such a problem, it is conceivable to provide a projection in a front part of the seat frame, and install a panel in a front part of the seat to raise the front end thereof. However, such a projection or a panel is too low to be effective and too high to provide a desired sitting comfort.

[0004] There have been various proposals. For instance, United States Patent No. 5,340,185 discloses a seat assembly using a wire and pulley arrangement for converting a forward movement of the seat in case of a vehicle crash into a lifting movement of the front edge of the seat. This arrangement uses the inertia force as a power source for actuating the front edge of the seat, and is advantageous in not requiring any other power source. However, the arrangement is highly complex, and there would be considerable difficulty in achieving a successful design. Japanese utility model laid open publication No. 3-61440 discloses a similar seat assembly relying on a propellant as a power source for selectively raising the front edge the vehicle speed. According to this arrangement, although it is necessary to restrain the vehicle occupant for a prolonged period of time depending on the situation, the seat front end will drop again after the thrust of the propellant actuator is used up, and this prevents this prior art arrangement from being truly effective in preventing a submarine phenomenon.

[0005] An automobile is often equipped with an emergency locking retractor (ELR) which locks up a winding shaft for the seat belt in case of a sudden stop or a vehicle crash. An ELR device is capable of locking up the winding shaft in a very short time upon detecting a deceleration level greater than a prescribed value so as to prevent any further pay-out of the seat belt. However, simply locking up the winding shaft would not prevent a pay-out of a length of the seat belt corresponding to the tightening of the part of the seat belt wound on the winding shaft. According to a pretensioner device proposed in the United States Patent No. 4,705,296, the buckle which is attached to an end of the seat belt is rapidly moved in the direction to tension the seat belt to enhance the restraining capability of the seat belt. Also, to prevent the buckle from moving backward immediately thereafter, the pretensioner device is provided with a reversing preventing device such as a ratchet and a one-way clutch, separately from that of the ELR device.

[0006] The inventors of this application has realized that such a pretensioner device is typically provided with a power unit for pulling the buckle powered by high pressure gas produced from a chemical reaction, for instance, as was the case with the invention disclosed in Japanese patent laid open publication No. 10-181529 by the same applicant.

BRIEF SUMMARY OF THE INVENTION

[0007] In view of such problems of the prior art, a primary object of the present invention is to provide a vehicle seat assembly which provides a sitting comfort under normal condition, but can prevent a submarine phenomenon in a reliable manner.

[0008] A second object of the present invention is to provide a vehicle seat assembly which is simple in structure so as to allow a high level of flexibility in layout.

[0009] A third object of the present invention is to provide a vehicle seat assembly which is economical to manufacture.

[0010] A fourth object of the present invention is to provide a vehicle seat assembly incorporated with both a pretensioner device and a submarine preventing device which requires a relatively small number of component parts and is suited for compact design.

[0011] According to the present invention, these and other objects can be accomplished by providing a vehicle seat assembly, comprising: a slip preventing member supported by a fixed part of a seat so as to be pivotable between a retracted position and a raised position; an actuator interposed between a fixed part of the seat and a part of the slip preventing member, and adapted to move the slip preventing member toward the raised position; and a lock mechanism for retaining the slip preventing member at the raised position. Typically, the slip preventing member comprises a lever member supported by a fixed part of the seat so as to be pivotable around a laterally extending pivot shaft, and a rod member extending along a front edge of the seat and attached to a free end of the lever member.

[0012] Thus, the present invention provides both a favorable sitting comfort under normal condition and a reliable operation in case of a high impact situation. The simple arrangement contributes to the economy, compactness and reliability of the arrangement. According

to a particularly preferred embodiment of the present invention, the slip preventing member comprises a pair of lever members supported on either side of the seat by a fixed part of the seat so as to be pivotable around a laterally extending pivot shaft, and a rod member extending along a front edge of the seat and attached across free ends of the lever members. In particular, at least one of the lever members preferably consists of a bell crank having a first end attached to the rod member, and a second end adapted to be actuated by the actuator which typically consists of a piston/cylinder arrangement including a propellant.

[0013] The lock mechanism may be selected from a number of possible arrangements such as a one-way lock mechanism provided around the pivot shaft, and a one-way lock mechanism incorporated between a piston rod and the cylinder.

[0014] Because the submarine preventing arrangement is preferably combined with a pretensioner for full protection of the vehicle occupant, and they are normally placed adjacent to each other, it is advantageous to use a common actuator. For instance, the pretensioner device may comprise a bell crank member which is pivotally supported by a fixed part of the seat so as to be pivotable around a pivot shaft extending laterally with respect the seat, the bell crank member having a first end attached to the buckle, and a second end attached to an end of the actuator which is common to the submarine preventing arrangement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Now the present invention is described in the following with reference to the appended drawings, in which:

Figure 1 is a perspective view of a vehicle seat assembly embodying the present invention:
Figure 2 is a partly broken away side view of the vehicle seat assembly of Figure 1;
Figure 3 is a sectional view showing the structure of a power unit of the vehicle seat assembly of Figure 1;
Figure 4 is a sectional view showing the structure of a ball-type one-way lock mechanism of the vehicle seat assembly embodying the present invention;
Figure 5 is a view showing a modified embodiment of the lock mechanism for retaining the slip preventing member at its raised position;
Figure 6 is a view showing another modified embodiment of the lock mechanism for retaining the slip preventing member at its raised position;
Figure 7 is a view showing yet another modified embodiment of th lock mechanism for retaining the slip preventing member at its raised position;
Figure 8 is a view showing yet another modified embodiment of the lock mechanism for retaining the slip preventing member at its raised position;
Figure 9 is a view similar to Figure 2 showing a second embodiment of the present invention; and
Figure 10 is a perspective view of an essential part of a third embodiment of the seat assembly according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] Figure 1 is a perspective view of a vehicle seat assembly S embodying the present invention, and Figure 2 is a partly broken away side view of this vehicle seat assembly S. A seat frame 2 is supported by seat rails 1 fixedly attached to the vehicle body so as to be slidable in the fore-and-aft direction, and can be selectively secured at a desired position by a lock mechanism not shown in the drawings. So far, the seat assembly is quite conventional. In the seat frame 2 are supported a bell crank or an L-shaped link member 3 and an arm 4 which are pivotally supported, at either side end of the seat frame 2, by a pair of pivot shafts 5, respectively, which are aligned on a common pivot axis extending in the lateral direction with respect to the vehicle body or perpendicularly through the paper of Figure 2. The L-shaped link member 3 includes a long arm section 3a and a short arm section 3b, and is pivotally supported at the intersection or the bent portion by the pivot shaft 5. The arm 4 can be considered as consisting solely of a long arm section, and is supported by the seat frame 2 at a base end thereof by the pivot shaft 5 which is hidden from view in Figure 1. The arm 4 can also consist of a bell crank identical to the L-shaped link member 3 for reducing the variations in the component parts although the short arm section of the bell crank 4 may not serve any useful purpose in that case.

[0017] The free ends of the long arm section 3a of the L-shaped link member 3 and the arm 4 are joined by a bar 6 extending laterally along a front edge of the seat, and serving as a main part of the slip preventing member. The free end of the short arm section 3b of the link member 3 is pivotally connected to a free end 9a of a piston assembly 9 of a power unit 7. The free end of the short arm section 3b of the link member 3 is provided with an elongated slot so as to accommodate the arcuate motion of the link member 3 to the linear motion of the piston assembly 9.

[0018] Referring to Figure 3, the power unit 7 comprises a cylinder 8 fixedly secured to the seat frame 2, a piston 9b which is slidably received in the cylinder 8, and a gas generator 10 received in the cylinder 8 on the base end of the piston 9b. A collar 11 is interposed between the piston 9b and the gas generator 10. The piston 9b engages the wall surface of the bore of the cylinder 8 via an O-ring. Therefore, by rapidly increasing the inner pressure of the cylinder 8 with the gas generator 10, the free end 9a of the piston assembly 9 may be projected from the cylinder 8 at high speed. The

opening on the working end (left end) of the cylinder 8 is reduced in diameter by swaging so as to engage the outer circumferential surface of the intermediate part of a piston rod 9c of the piston assembly 9.

[0019] Meanwhile, the support portion 5 is provided with a ball-type one-way lock mechanism 12 as shown in Figure 4. The ball-type one-way lock mechanism 12 comprises a cam member 13 which is integral with the link member 3, a ring member 14 which is integral with the seat frame 2 and concentrically surrounds the cam member 13 so as to be rotatable relative to the cam member 13, and a large number of balls 15 which are each individually received in a chamber defined between the cam member 13 and the ring member 14. The outer peripheral edge of the cam member 13 is wavy in shape, defining inclined surfaces 13a at a regular interval so that each of the chambers defined between the cam member 13 and the ring member 14 gets narrower in a circumferential direction by virtue of the inclined surfaces 13a. Each of the balls 12 can wedge in the gap defined between the wall surfaces of the cam member 13 and the ring member 14 in the narrow part of the corresponding chamber so as to fixedly secure the two parts relatively to each other. Each of the balls 15 is urged toward the narrower part of the chamber by a sheet spring 16 formed by bending a piece of a common plate member. Therefore, as the link member 3 turns in the clockwise direction in Figure 2, or as the bar 6 on the free end of the long arm section 3a moves upward, the balls 15 are allowed to roll freely toward the broader part of the corresponding chambers. However, as the link member 3 turns in the counter clockwise direction in Figure 2, or as the bar 6 on the free end of the long arm section 3a moves downward, the balls 15 are forced to roll toward the narrower part of the corresponding chambers so that the bar 6 is prevented from moving, and is retained at that position.

[0020] Now the mode of operation of this embodiment is described in the following. First of all, when an impact such as that produced by a vehicle crash is detected by a sensor or the like not shown in the drawing, gas is produced from the gas generator 10, and rapidly increases the inner pressure in the cylinder 8, causing the free end 9a of the piston assembly 9 to project from the cylinder 8 at high speed. Then, because the link member 3 attached to the free end 9a of the piston assembly 9 turns in clockwise direction, and the free end of the short arm section 3b is connected to the power generator 7, the bar 6 is raised via the long arm section 3a as indicated by the imaginary lines in Figure 2. This in turn causes a front part of the seat to rise, and thereby prevents the submarine phenomenon from occurring to the vehicle occupant. Even after the gas ceases to be produced from the gas generator 10 thereby stopping the generation of power from the power unit 7 or the drive force from the power unit 7, the ball-typ one-way lock mechanism 12 prevents the raised bar 6 from moving down, and thereby maintains the capability to prevent the submarine phenomenon.

[0021] Figures 5 to 8 show alternate embodiments of the lock mechanism for retaining the bar 6 serving as the slip preventing member at its raised position.

[0022] In the embodiment illustrated in Figure 5, a ratchet wheel 20 is fixedly attached to the intersection or the bent part of the L-shaped link member 3, and a pawl 21 pivotally supported on the seat frame 2 is urged by a spring 22 into engagement with the ratchet wheel 20.

[0023] In the embodiment illustrated in Figure 6, the lock mechanism is incorporated in the power unit 7. A casing 23 is fixedly secured to the cylinder 8 or the seat frame 2 so as to surround the outer periphery of the piston rod 9c, and a number of balls 24 and springs 25 for urging the balls 24 in the direction to retract the piston rod 9c are received in a chamber defined between the piston rod 9c and the casing 23. The inner wall of the casing 23 is inclined to make the chamber narrower on the side of the base end of the piston assembly 9 than on the side of the free end of the piston assembly 9. This arrangement operates in a substantially similar manner as the ball-type one-way lock mechanism. In other words, the piston assembly 9 is allowed to move freely in the projecting direction, but prohibited from moving into the cylinder 8 because the balls 24 wedge into a gap defined between the piston rod 9c and the wall surface of the casing 23, and prevent any further movement of the piston assembly 9.

[0024] In the embodiment illustrated in Figure 7, a chamber is defined inside the cylinder 8 of the power unit 7 between the inner wall surface of the cylinder 8 and the piston 9b, and a number of balls 26 and springs 27 for urging the balls 26 in the direction to retract the piston assembly 9 are received in this chamber. The outer circumferential surface of the piston 9b defines an inclined surface inside the chamber in such a manner that the chamber gets narrower from the base end of the piston assembly to the free end thereof. As it operates in a substantially same manner as that illustrated in Figure 6, a detailed description of the operation of this embodiment is omitted.

[0025] In the embodiment illustrated in Figure 8, the lock mechanism is incorporated in the power unit 7. A casing 28 is fixedly secured to the cylinder 8 or the seat frame 2 so as to surround the outer periphery of the piston rod 9b, and a number of engagement pieces 29 and springs 30 for urging the engagement pieces 29 toward the base end of the piston 9b or toward the cylinder 8 are received inside the casing 28. The outer peripheral surface of each of the engagement pieces 29 is gradually diminished in outer diameter from the free end of the piston assembly 9 to the base end thereof. The interior of the casing 28 includes a large diameter section 28a and a tapered section 28b which is progressively reduced in diameter away from the large diameter section 28a. Therefore, the engagement pieces 29 engage the outer circumferential surface of the piston 9 because

the engagement pieces 29 are urged by the springs 30 and pressed upon by the tapered section 28b as a result in the state illustrated in Figure 8. However, as the piston assembly 9 moves in the projecting direction or in the direction to raise the bar 6, the engagement pieces 29 are moved in the projecting direction of the piston assembly 9 against the urging force of the springs 30 until they reach the large diameter section 28a, thereby disengaging themselves from the piston rod 9c, and allowing the piston assembly 9 to move freely. Conversely, when the piston assembly 9 is moved in the retracting direction, the engagement pieces 29 are moved in the direction of the tapered section 28b under the urging force of the springs 30, and engage the outer circumferential surface of the piston rod 9c so as to fixedly secure the piston rod 9c thereto. This arrangement alone can provide a lock mechanism, but annular grooves or projections or a screw thread are formed on the inner circumferential surface of each engagement piece 29. The base end of the piston rod 9c is also provided with corresponding annular grooves or projections or a corresponding screw thread. Therefore, when an attempt is made to move the piston assembly 9 in the retracting dircction, the inner circumferential surface of each engagement piece 29 and the outer circumferential surface of the piston rod 9c engage each other, and firmly retain each other.

[0026] Figure 9 is a view similar to Figure 2 showing another embodiment of the present invention. In this drawings, the parts corresponding to those in Figure 2 are denoted with like numerals without repeating a detailed description of such parts. In this embodiment, the power unit 2 shown in Figure 2 additionally serves as a power unit for moving a buckle of a seat belt in the tensioning direction in a pretensioner device 31 for automatically tensioning a seat belt in case of a vehicle crash. The ball-type one-way lock mechanism 12 described above or the modified embodiments thereof (Figures 5 to 8) additionally serves as a lock mechanism for retaining the buckle 32 of the seat belt at a position for maintaining a tension in the seat belt.

[0027] More specifically, the pretensioner device 31 comprises a bell crank or a rotary arm 34 pivotally attached to a side of the seat so as to be rotatable around a laterally extending pivot axis. The rotary arm 34 is provided with a first end which is pivotally attached to a base end of the buckle 32, and a second send which is pivotally attached to a link member 33 which is in turn pivotally attached to the free end 9a of the piston assembly 9 of the power unit 7. Thus, when an impact due to a vehicle crash or the like is detected by a sensor not shown in the drawing, gas is generated from a gas generator 10, and the resulting rapid increase in the inner pressure of the cylinder 8 causes the free end of the piston assembly 9 to project from the cylinder 8 at high speed. As the bar 6 moves or projects upward, the buckle 32 is pulled downward as indicated by the imaginary line at the same time, applying a tension to the seat belt and increasing the restraining force for the vehicle occupant. Even when the drive force of the power unit 7 is all spent, because the ball-type one-way lock mechanism or any one of the modifications thereof (Figures 5 to 8) prevents the reversing of the buckle 32 or the slackening of the seat belt.

[0028] The link member 3 consisted of an L-shaped member in the above described embodiments, it is also possible to rotatably support a bar 6' having a C-shaped middle section which is provided with a lever 3' at an end thereof as illustrated in Figure 10, and to drive this lever 3' with the power unit 7 so as to selectively raise the C-shaped part of the bar 6'. In this embodiment also, to accommodate the arcuate motion of the lever 3' to the linear motion of the power unit 7, the output end of the power unit 7 is connected to the lever 3' via a pin and slot arrangement similar to that shown in Figure 2.

[0029] As can be appreciated from the above description, according to the vehicle seat assembly of the present invention, a slip preventing member for preventing the vehicle occupant from slipping forward under the seat belt in case of an impact is either directly or indirectly connected to a power unit which can project a piston received in a cylinder with gas generating means in such a manner that the slip preventing member is projected upward upon detecting an impact to the vehicle, and is retained at its projected state with a lock mechanism. Therefore, in a case of an impact, a submarine phenomenon can be prevented in a reliable manner, and the simplicity in structure allows a high level of flexibility in layout. In particular, when the power unit additionally serves as a power unit for moving a buckle of a seat belt in the tensioning direction in a pretensioner device for automatically tensioning a seat belt in case of a vehicle crash, the number of necessary component parts can be minimized, and the device can be compactly designed.

[0030] Although the present invention has been described in terms of preferred embodiments thereof, it is obvious to a person skilled in the art that various alterations and modifications are possible without departing from the scope of the present invention which is set forth in the appended claims.

Claims

1. A vehicle seat assembly, comprising:

   a slip preventing member supported by a fixed part of a seat so as to be pivotable between a retracted position and a raised position;
   an actuator interposed between a fixed part of said seat and a part of said slip preventing member, and adapted to move said slip preventing member toward said raised position; and
   a lock mechanism for retaining said slip pre-

venting member at said raised position.

2. A vehicle seat assembly according to claim 1, wherein said slip preventing member comprises a lever member supported by a fixed part of said seat so as to be pivotable around a laterally extending pivot shaft, and a rod member extending along a front edge of said seat and attached to a free end of said lever member.

3. A vehicle seat assembly according to claim 1, wherein said slip preventing member comprises a pair of lever members supported on either side of said seat by a fixed part of said seat so as to be pivotable around a laterally extending pivot shaft, and a rod member extending along a front edge of said seat and attached across free ends of said lever members.

4. A vehicle seat assembly according to claim 3, wherein at least one of said lever members consists of a bell crank having a first end attached to said rod member, and a second end adapted to be actuated by said actuator.

5. A vehicle seat assembly according to claim 4, wherein said actuator comprises a piston/cylinder assembly connected between said second end and said fixed part of said seat, said piston/cylinder assembly comprising a gas generator received in said cylinder.

6. A vehicle seat assembly according to claim 1, wherein said lock mechanism comprises a one-way lock mechanism provided around said pivot shaft.

7. A vehicle seat assembly according to claim 1, wherein said lock mechanism comprises a one-way lock mechanism incorporated between a piston rod and said cylinder.

8. A vehicle seat assembly according to claim 7, wherein said lock mechanism is provided inside said cylinder.

9. A vehicle seat assembly according to claim 7, wherein said lock mechanism is provided outside said cylinder.

10. A vehicle seat assembly according to claim 1, further comprising a seat belt pretensioner device which is adapted to selectively move a seat belt buckle in a direction to apply a tension to a seat belt and powered by said actuator.

11. A vehicle seat assembly according to claim 10, wherein said pretensioner comprises a bell crank member which is pivotally supported by a fixed part of said seat so as to be pivotable around a pivot shaft extending laterally with respect said seat, said bell crank member having a first end attached to said buckle, and a second end attached to an end of said actuator.

Fig. 1

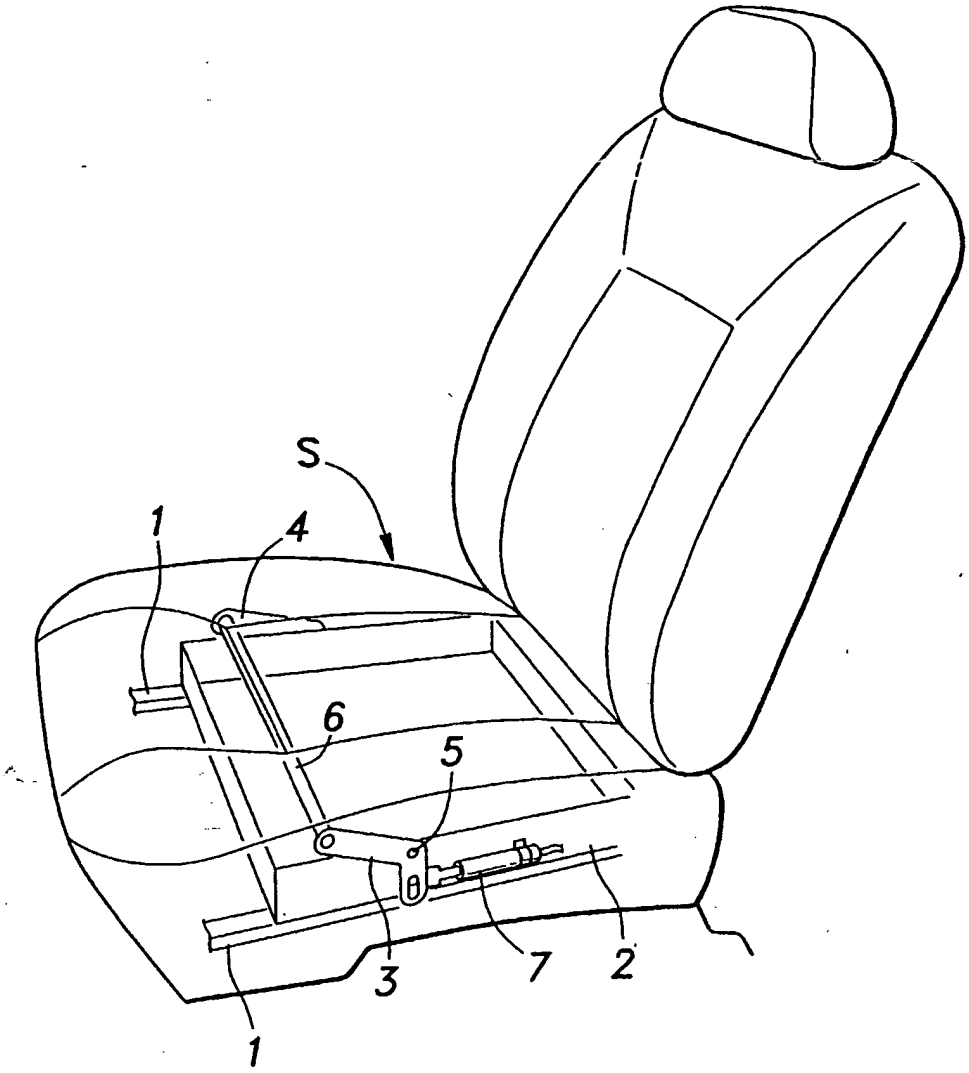


Fig. 2

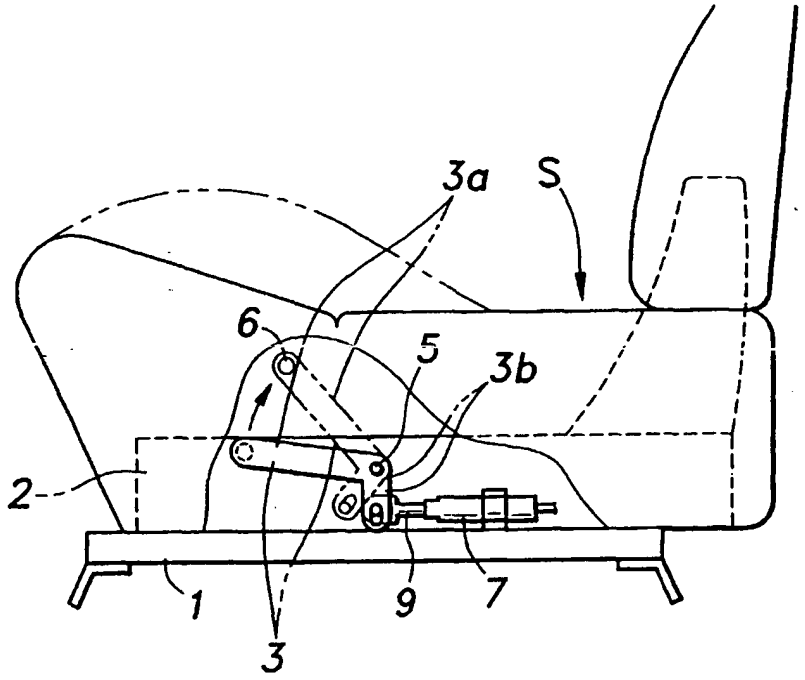


Fig. 3

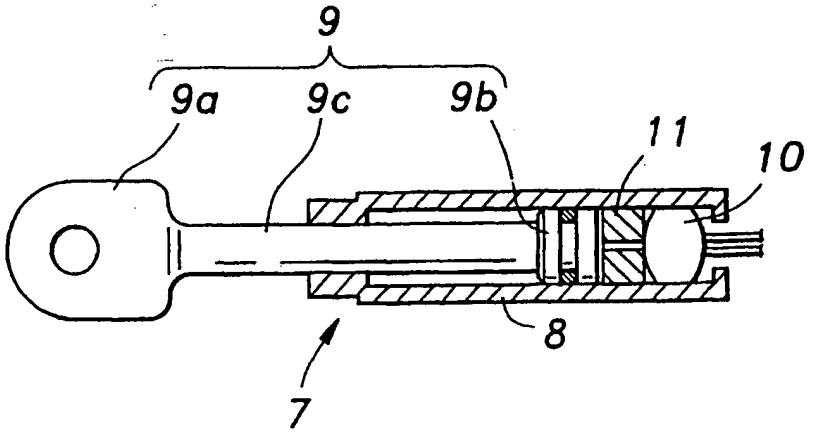


Fig. 4

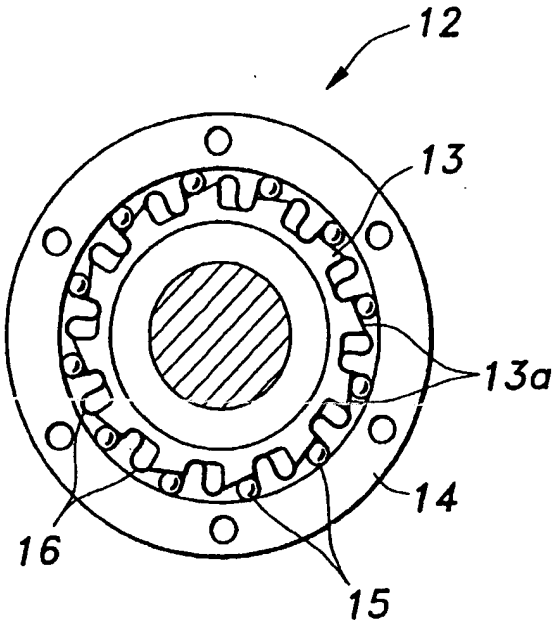


Fig. 5

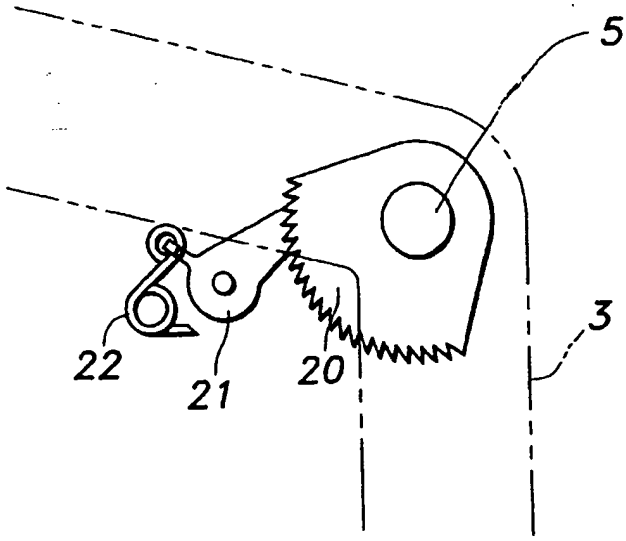


Fig. 6

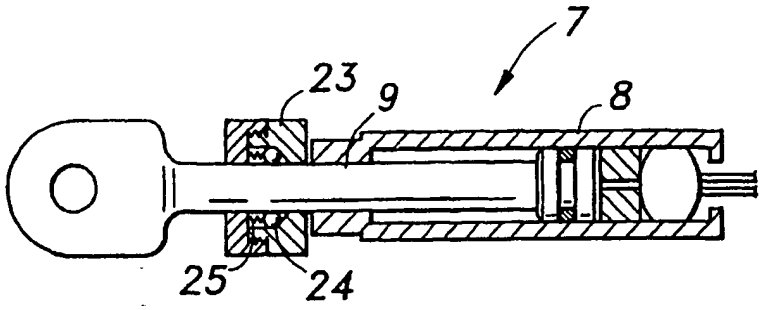


Fig. 7

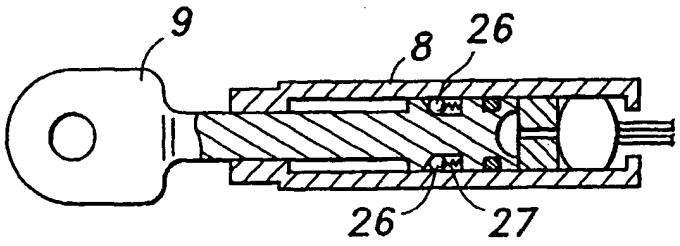


Fig. 8

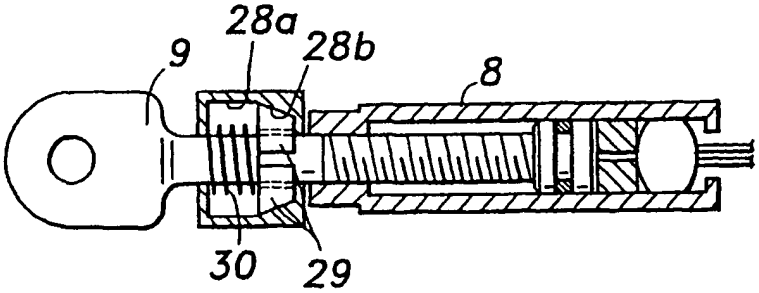


Fig. 9

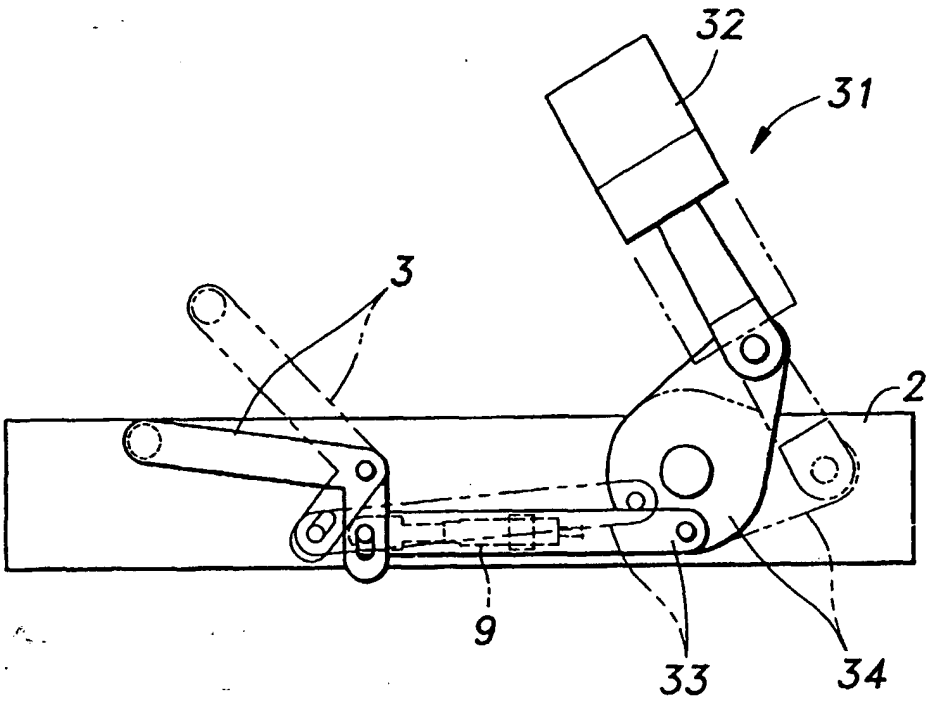


Fig. 10